Formulae - Mechanics

Velocity (m/s) **$v = d / t$ & $v = u + at$ & $v = \sqrt{u^2 + 2ad}$**

Distance (m) **$d = \frac{1}{2}(u + v)\, t$ & $d = ut + \frac{1}{2}at^2$**

Acceleration (m/s^2) **$a = \Delta v / t$**

Acceleration due to gravity (g) = $9.81 m/s^2$

Force (N) **$F = ma$** (mass measured in kg)

Frictional Force = **mgf**

Weight (N) = mg

Momentum (kg/m/s) M = mv

Work (J) **$W = Fd$**

Power (W) = **W/t** = Fd/t = Fv

Pressure (N/m^2) **$P = F/A$**

Potential Energy (J) **$E_p = mgh$**

Kinetic Energy (J) **$E_K = \frac{1}{2}mv^2$**

Density (kg/m^3) p = m/vol

Formulae - Electricity

Voltage (Volts) = V

Current (Amps) = I **$I = \frac{V}{R}$**

Resistance (Ohms) = R

Power (Watts) = VI

R tot (series) = R1 + R2 + R3 + ……

R tot (parallel) = 1/R1 + 1/R2 + 1/R3 + …..

Formulae - Hydraulics

1 bar = 100 kpa = 10 metres head = 100,000 N/m^2

Flow (l/min) $\mathbf{L = \frac{vd^2}{21.2}}$ $\mathbf{L = \frac{2}{3}d^2\sqrt{P}}$ (pressure in bar)

Nozzle Output (l/s) = $\mathbf{0.0011d^2\sqrt{P}}$ (pressure in kpa , nozzle diameter in mm)

Velocity (m/s) $\mathbf{v = \frac{21.2L}{d^2}}$

Pressure loss due to friction (kpa) $P_F = \frac{2000flv^2}{d}$ (hose diameter in mm)

Head loss due to friction (metres head) $\mathbf{H_F = \frac{2flv^2}{Dg}}$ (hose diameter in m)

Metres Head (m) $\mathbf{Hm = \frac{v^2}{2g}}$ Velocity(m/s) $v = \sqrt{2gh}$

Jet Reaction $J_r = \frac{2Pa}{1.}$ & $\mathbf{Jr = \frac{1.57Pd^2}{1000}}$

Theoretical Height of Jet (m) **$\mathbf{Ht = Hm - (0.113\, Hm^2/d)}$**

Effective Height of Jet (m) $He = \frac{2}{3}(Ht)$

Water Power (watts) WP = l/s x P

Brake Power (watts) BP = WP/E Pump Efficiency = WP/BP x 100%

Capacity of a water main = $\frac{\sqrt{SP}}{D}$ x l/s

Capacity of hose = $\frac{7.854\, d^2}{10000}$

Formulae - Heat

Kelvin (K) = ºC + 273

ºF = (ºC x $_{9}/_{5}$) + 32 ºC = (ºF – 32)$_{5}/_{9}$

Heat Absorbed/Released (kJ)
= specific heat (KJ/kg/ºC) x m x ΔT

= latent or fusion heat(KJ/kg) x m

Linear Expansion ΔL = L_0 x co-eff linear exp. x ΔT

Boyles Law = volume of a gas is inversely proportional to its pressure for a given mass at a constant temperature

$$P_1V_1 = P_2V_2$$

Charles Law = volume of a gas is directly proportional to its kelvin temp for a given mass at constant temperature

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Guy Lussacs Law = the pressure of a gas is directly proportional to its kelvin temperature for a given mass at a constant volume

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Combined Gas Law = $$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$